ARTICLES

Mediterranean Botany
ISSNe 2603-9109

EDICIONES COMPLUTENSE

https://doi.org/10.5209/mbot.71209

Plant Conservation Biology: a view from the Mediterranean ecoregions

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Received: 27 August 2020 / Accepted: 24 November 2020 / Published online: 12 April 2021

Abstract. This Special Issue provides an overview of the current status of plant conservation biology in Spain and other regions around the World. Papers represent selected outstanding presentations made during the 9th Congress of the Spanish Society of Plant Conservation Biology, which took place in Granada (Spain) on July 9–12, 2019. These papers cover different topics, all present illustrating trends in plant conservation biology. They highlight the important contribution of different approaches to plant conservation in the area. This special issue is dedicated to the Spanish botanist José Antonio Fernández Prieto (1950-2019).

Keywords: Conservation Biology; functional biodiversity; gap analysis; genetic conservation; machine learning; Mediterranean-type ecosystems; modelling; population biology; taxonomic status.

How to cite: Mendoza-Fernández, A.J., Salmerón-Sánchez, E., Lorite, J., Mota, J.F. & Peñas, J. 2021. Plant Conservation Biology: a view from the Mediterranean ecoregions. Mediterr. Bot. 42, e71209. https://doi.org/10.5209/mbot.71209

Conservation Biology is a scientific discipline whose history dates back almost 40 years (Soulé, 1986). Although during this time, it has studied the causes for the loss of biological diversity at all levels, i.e., genetic, individual, specific, eco-systemic (Wood *et al*., 2000), biodiversity losses are still documented at high rates. Plants are considered a fundamental part of global biodiversity. However, if threatening factors for plant diversity are not decelerated or stopped, significant opportunities to develop solutions might be missed (Moreno-Saiz *et al.*, 2018). Therefore, the advancement of research lines to minimize the loss of plant diversity should be a fundamental task in the current changing scenario. During the 9th Spanish Congress on Plant Conservation Biology (SEBiCoP biennial meeting), held in Granada, on July 9-12, 2019, 135 presentations were given during the plenary or thematic sessions. As a sample of the main results and conclusions obtained during the congress, a selection of them is hereby presented.

Papers published in this volume deal with theoretical and practical plant studies on plant and vegetation restoration and management, conservation status, main threats to plant diversity hotspots, species or community modeling. The selected papers gather subjects on the three components of biodiversity, i.e., composition, structure, and function, at all levels of organization that encompass the biodiversity of an area and should be considered in conservation (Noss, 1990). Among them, several case studies exemplify current trends and highlight the importance of the development of different approaches in plant conservation. An initial paper intends to provide a review of state-of-the-art plant conservation in Mediterranean-type Ecosystems during the last fifty years (Salmerón-Sánchez *et al*., 2021). As a result of this study, the asymmetry regarding progress in research between Mediterranean countries is shown; also, public organizations' role as funders proves to be fundamental. Additionally, a decrease in typical subject categories related to Plant Conservation (such as Plant Sciences, Management, or Conservation actions) and an increase in other related subcategories was exposed.

One of these increasing subcategories corresponds to the use of machine learning methods in plant science. An example of this is presented by Mota-Merlo & Martos (2021), who resorted to this type of technique to classify plants from extreme edaphic environments, specifically serpentines. Heavy metal contents (in soil and plant tissues) were used to classify plants according to their ability to accumulate them. Hyperaccumulator species are closely linked to particular substrates, such as serpentine, where endemic plants are common. Due to their narrow distribution and habitat specificity, these plant endemics present high vulnerability and a high probability of being endangered. Therefore, these species' conservation status is also of great interest according to the IUCN and national Red Lists, especially in those countries where serpentines are frequent.

Another novel statistical technique is used by Bou *et al.* (2021), which combined the classical phytosociological approach and the use of Generalized Linear Models (GLMs). This study aimed to evaluate conservation interests in the sessile oak forests in the Northeast of the Iberian Peninsula. The authors analyzed the relationship of the conservation indicators together with the environmental variables. Afterward, the protected

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areas network's efficiency in safeguarding this habitat was evaluated, and several criteria were established to improve the conservation strategy of sessile oak forests.

Population biology remains a basic part of Conservation Biology. A good example has been put forward by Agea *et al.* (2021) by evaluating the population structure and niche regeneration at the microhabitat scale of threatened species *Euonymus latifolius* (L.) Mill. They concluded that this species is in a critical situation in south-eastern Spain, suffering serious regeneration problems due to climatic change, intrinsic characteristics of the species, and human-mediated factors.

Genetic techniques are already widely used in Botany and are very interesting to discriminate species, but classical knowledge in this discipline is still fundamental. Sánchez-Gómez *et al.* (2021) endorse this fact by using ITS molecular markers in addition to morphological characters to clarify and establish the taxonomic status of *Geum atlanticum* Desf., considered as a part of *Geum sylvaticum* Pourr., which shows a wider distribution.

Furthermore, in many cases, molecular analysis results are combined with those from species distribution modeling (SDMs) to be used for wide conservation purposes. Rojo *et al.* (2021) studied black alder forests at the rear edge of their distribution in Europe, where the critical temperature-relevant periods strongly regulate the reproductive phenology of the species. Additionally, Bobo-Pinilla *et al.* (2021) proposed a reinforcement planning of the most depauperated populations of the species *Astragalus edulis* Bunge to preserve its genetic diversity and identified the areas that will present optimal climatic conditions for the future survival of this species. Moreover, López-Gonzalez *et al.* (2021) used this procedure to seek potential new localities for the nothotaxon *Veronica* x *gundisalvi.*

Regarding chorological information, the authored approach by Alba-Patiño *et al.* (2021) is noteworthy. They performed a study to determine Sites of Special Importance for the Conservation of Threatened Orchid Species in Colombia (SSICO) through an analysis of their spatial and altitudinal distribution range with the aid of Marxan software (a software suite specifically designed to determine reserve areas), considering relevant features such as richness, rarity and conservation status. Results were compared to perform a gap analysis of the protected Areas System in Colombia, then proposing SSICOs to fill the conservation gaps.

Finally, a recent line of research has emerged in the biophysical-social interface. This is reflected, for instance, in the identification of ecoregions with the aid of the detection of Ecosystem Functional Types (EFTs). Pérez-Cazorla *et al*. (2021) examined the relationships between biological regionalization based on structure and composition (species distribution, endemics, vegetation types), and patterns of ecosystem functioning revealed by the geographical distribution of EFTs in the Baja California Peninsula. The authors consider that due to the development of new techniques based on remote sensing, functional features measured at regional scales could be incorporated, allowing them to complement the traditional view of ecosystems. Thus, this approach may provide the basis for a more comprehensive regionalization of geographical patterns of life and improve future conservation purposes.

The papers presented in this special issue of *Mediterranean Botany* cover a wide range of plant conservation topics. They show how the development of different research methodologies has addressed the different problems associated with the conservation of plant species and habitats in Mediterranean areas and other ecosystems such as deserts and tropical areas.

This special issue is dedicated to the Spanish botanist José Antonio Fernández Prieto (1950–2019). Professor Fernandez Prieto was born in Mieres (Asturias) and studied Biology at the University of Oviedo, where he spent all his professional life practically as a professor and researcher. He published more than 200 scientific articles throughout a career in which he also held relevant positions. He was head of the Institute of Natural Resources and Spatial Planning (Indurot) between 1997 and 2001. Later, until 2007, he leaded and developed the Gijon Atlantic Botanical Garden's scientific section. As a member of the Real Instituto de Estudios Asturianos (RIDEA) from 2010, professor Fernández Prieto was awarded by the Department of Culture of the Regional Government of the Principality of Asturias with the prize "Juan Uria Ríu" for his research work called "The Botanical Expedition to Asturias by Michel Charles Durieu de Maisonneuve in 1835". He was a member of the Spanish committee's scientific council for Man and the Biosphere Program, from 2007 to 2016.

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